LOCH NESS MONSTER EVIDENCE PRESENTED AT CORNELL UNIVERSITY

On May 4th, an audience of 1500 Cornell faculty and students examined the most recent photographic and sonar evidence for the existence of large unidentified animals in Scotland's Loch Ness. It was the first time that these data had been presented publicly and then opened to critical evaluation by a group of scientists. Although the event was covered by Associated Press and received international syndication, it was felt that a more detailed published account with some of the original data would be of value, and especially because of its potential special interest to the herpetological community.

The purpose of the program was to provide a forum for a long-overdue public examination of the evidence by scientific experts, but it was also intended as an educational device to demonstrate for students the ways in which science approaches new discoveries which, by their very nature, are often on the edge of believability. The lecture was presented by Charles W. Wyckoff, president of Applied Photo Sciences, Inc., of Needham Heights, Massachusetts. Mr. Wyckoff, a widely-respected inventor of wide-exposure-range films, is the photographic consultant to the Loch Ness Project sponsored by the Academy of Applied Science of Boston. Mr. Wyckoff's lecture was followed with a panel discussion by distinguished Cornell faculty, among them several members of the U. S. National Academy of Sciences and including experts in remote sending, imagery, vertebrate anatomy, paleontology, and biology. I organized the event and served as moderator.

Mr. Wyckoff's Lecture

Mr. Wyckoff began by giving a description of Loch Ness, the largest body of fresh water in the British Isles. It is about 24 miles long, 1.5-2 miles wide, and has a nominal depth of 700 feet, although depths of 975 feet have been recorded;the sides of the Loch are quite steep (Fig. 1). The waters are cold year-round, varying by only a few degrees from about 42°F. The water has a yellow-brown color due to large quantities of suspended peat particles which reduce underwater visibility to a few feet. Wyckoff's group has worked primarily in Urquhart Bay along the west shore of the loch since this area accounted for the largest number of sightings of the monster over the last several decades. Furthermore, the beasts are thought to feed on salmon that regularly congregate in Urquhart Bay before migrating upstream to spawn.

The first recorded sightings of a "monster" in Loch Ness was by St.Columba in 565 A.D. After the construction of a modern road along the west side of the lake in the 1930's the number of reported sightings increased dramatically but, as Mr. Wyckoff pointed out, there were a number of hoaxes and several photographs were obvious fakes. Perhaps the most famous of the supposedly authentic photographs is the "surgeon's photograph" (Fig. 2) taken in 1934 but, typical of surface photographs, it is a silhouette and shows no detail;furthermore, Mr. Wyckoff noted that there is no sense of scale.

The present series of photographs and sonar data was obtained by members of the Loch Ness Project sponsored by the Academy of Applied Science, a private organization of several hundred scientists, inventors and industrialists devoted to the support of unusual areas of research. The Project is led by Dr. Robert H. Rines,a Boston patent attorney and Dean of the Franklin Pierce Law Center in New Hampshire. In 1972 they obtained the famous "flipper" photographs, together with a simultaneous sonar record (Fig. 3). But as Wyckoff noted, these photographs suffer from the back-scatter of light

from suspended peat particles and the photos, therefore, required computer enhancement, a process that sharpens an image but does not falsify the record.

In order to minimize the light-scattering problem during the 1975 season, Wyckoff separated the light source from the camera (Fig. 4) and further improved the system by using a sonar-gated signal that turned on the cameras only when a target of sufficient size came within camera view. These techniques were successful in producing the dramatic color photographs in Plate I, which, according to Wyckoff and his colleagues, show various portions of the head, neck and body of one of the creatures.

After last summer's work the Rines-Wyckoff group made plans to present their data to zoologists at a meeting organized by the Royal Society to be held in Edinburgh last December. But at the last minute the meeting was cancelled by the organizers due to premature adverse publicity that was precipitated by the publication of a revised edition of Witchell's "The Loch Ness Story" which contained a detailed description of the 1975 data but no photographs. At the same time, the Rines group was further criticized for publishing a formal scientific name for the Loch Ness Monster (Nessiteras rhombopteryx Scott and Rines, 1975). But, as Wyckoff noted, the sole purpose of this article was to facilitate full protection for the beast in the event that its existence was proved since, under British law, protection can be granted only to organisms having a scientific name. Nevertheless, a confidential presentation of the data was made by the group to a joint committee of both Houses of Parliament and protection now seems assured.

Wyckoff concluded his lecture by saying that this summer's expedition will use the same equipment as before, but also underwater television directed at the cameras so that any disturbance of the apparatus by the beast can be witnessed. Furthermore, they will be using high-resolution sonar in order to locate any skeletal remains on the silty bottom of the loch before recovering them. He noted that although they have succeeded in overcoming much of the stigma of ridicule, they have had to support the entire operation from their own private funds.

The Panel Discussion

After Mr. Wyckoff's lecture, six Cornell faculty were invited to the stage to make comments on the data and to question the speaker. Each had been given copies of the data in advance; only the more substantive points are recorded here.

Dr. Melvin L. Kreithen, a specialist in vertebrate sensory physiology, pointed out that the greatest strength of the approach used by Wyckoff and his colleagues is that three different modalities are involved simultaneously: photographic, sonar and the mechanical disturbance of the cameras (Plate I). Kreithen asked if the sonar records could be caused by sound echoing off of thermoclines, but Wyckoff noted that at the observation site the thermoclines were at depths of several hundred feet, well beyond the range of the cameras.

Dr. Thomas Eisner, a behavioral ecologist, asked why hydrophones had not been used to detect possible sounds made by the beasts. He pointed out that sounds undoubtedly are made when the camera is disturbed or simply when any object moves past the cameras. Furthermore, in the murky waters of the Loch, it seems reasonable to expect any large, widely-spaced-out animals to use echolocation to find prey and mates. Wyckoff answered that hydrophones had indeed been used, that there were no positive results and they were discontinued after the 1971 season. Nevertheless, he now feels that the sound frequency spectrum was too narrow

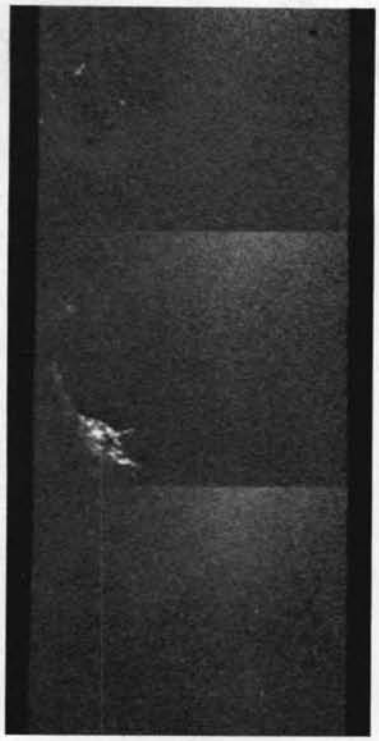
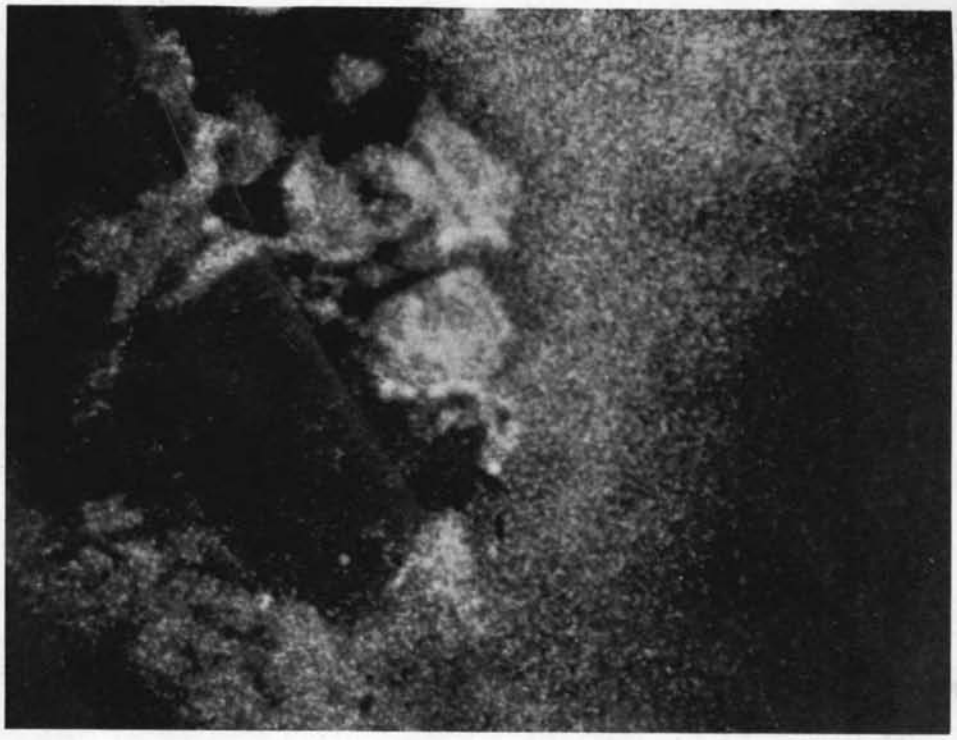


PLATE I (A) Photograph taken at 4:32 AM, 20 June 1975, purportedly of the upper body, neck and head; note absence from adjacent frames taken at 1.2 min intervals from center shot. Light cone and densitometric measurements indicate that "body" was at distance of 25 ft and "neck" was about 10 ft long.



(B) Photograph taken at 11:45 AM, 20 June 1975, showing "head". This series of six frames (intervals, 1.2 min) records a period of major disturbance, with the camera swinging upward; note bottom of boat, length 20 ft. The center shot, enlarged at right, is interpreted by Wyckoff's group as the head, showing bilateral symmetry in half-profile; note the mouth and nostrils at right and the several horn-like protrusions. An interpretive drawing by Sir Peter Scott is shown at bottom. The "head" was about 5 ft from the camera and is estimated to be 2 ft long. Camera-strobe arrangement for all photos in plate I is shown in fig. 4. (All photographs copyright Academy of Applied Science)

and that these experiments should be repeated.

Dr. Donald J. Belcher, an authority on remote sensing data, made an interesting point concerning the "surgeon's photo" (Fig. 2). He noted that the beast appears to have set up a series of refractory waves that interrupt the entire wave pattern surrounding it. This would imply that the object had a considerable mass and tends to rule out the common criticism that it is merely a bird or some other small object.

Dr. Howard E. Evans, an anatomist and authority on aquatic vertebrates, stated that he had no doubt that the photos were of living creatures but he interpreted them to be a giant sturgeon, noting the existence of the white sturgeon of Russia which reaches a length of 24 feet. Evans suggested that Plate IA might be the tail-end of a sturgeon, and the "head" in IB the mouth-parts of an upside-down sturgeon in which the so-called "tentacles" are simply barbels. The failure to recover any skeletal remains could be accounted for by the fact that these fish are cartilaginous and perhaps only the dermal plates would become fossilized. Finally, he suggested that the concentration of monster sightings in Urquhart Bay might be due to its use as a sturgeon spawning site rather than a place to capture migrating salmon. Wyckoff remarked that sturgeon have never been reported anywhere in the British Isles, but that they had already considered this possible interpretation of their photographs and rejected it.

Dr. Carl E. Sagan is an astronomer and is noted for his work on the Mariner probes of Venus and Mars, projects involving some of the same photographic enhancement techniques used in the Loch Ness Project. Sagan stated that the possibility of a hoax in this instance is quite remote because of the reputations of the persons involved and because of the elaborateness necessary to perpetrate a hoax when the data-gathering techniques are so sophisticated and involve so many simultaneous modalities. He also remarked that he had contacted his associates at the Jet Propulsion Laboratory in Pasadena, California, where the Loch Ness photos had been processed and they are convinced of the photographs' authenticity. Sagan felt that the Rines-Wyckoff data, although not definitive, were the best hard evidence now available and cause him to believe that large unidentified organisms do exist in Loch Ness.

Sagan then mentioned his recent calculation of the possible number of monsters in Loch Ness, based on the mean-free-time method of collision physics. A rough measure of the number can be calculated based on the collision distance (the camera's range), the organism's velocity and the average time between encounters. His estimate of a number of beasts is "between several tens and several hundreds"(Sagan, 1976), with an average separation distance between animals of about 0.4 km. He said that the number density estimate is, interestingly, about the same as that derived by completely independent means based on biomass calculations that assume a diet of fish (Sheldon and Kerr, 1972). Wyckoff added that if we assume that each of the half dozen locations where sightings are most numerous represent a "family group", then the total number of individuals in Loch Ness may similarly be in the same range of values.

Dr. John W. Wells, a geologist and paleontologist, stated that during the Pleistocene Loch Ness was filled to the bottom with ice since it has the typical transverse profile of a glaciated valley. Since the ice receded about 12,000 years ago, any monsters must have come in from the sea after that time. Wells said it was highly unlikely that any Mesozoic marine reptiles such as Plesiosaurs could have done so since there are no fossil records beyond the Mesozoic, and that all species were tropical in distribution He suggested that the

beasts may be fish and noted the discovery of the carcass of a basking shark on the shore of Loch Ness in 1942.

Concerning the new photographs, Wells thought that some of them looked like old logs whose rapid movement in and out of camera view (Plate I) could be accounted for by the passage of internal waves which cause no surface movement, yet involve a very considerable transfer of energy. Wyckoff noted that in one of the photographs a cylindrical object with a diameter of 6-8 ft was observed, yet there are no trees in the vicinity of Loch Ness today having diameters in excess of 4 ft. Wells countered with the suggestion that the submerged trunks could have been remnants of the very large trees of the great Caledonian Forest of Scotland, which burned down within historic times.

Personal comments: Although there was disagreement amongst the panel the data are actually derived from more than one sort of thing, all agreed that there are large unidentified objects in Loch Ness that require a rational explanation. Certainly this is an important step forward for this work, since many critics have regarded the "monsters" as a complete myth having no substance whatever. The weight of the data collected by the Rines-Wyckoff group has slowly had an impact on those willing to consider it in detail and the presentations before Parliament and at Cornell together with positive comments by several prominent scientists elsewhere, have given credibility to this team's efforts. This increased confidence was recently demonstrated by the announcement that The New York Times has decided to financially support this summer's effort. The Academy team left for Loch Ness on May 30 for a full summer's work. This is being covered by an NBC film crew and Times reporters and photographers have been sending back regular dispatches. The methods being used this summer are more extensive and sophisticated than ever before used at Loch Ness. This, coupled now with the cooperation of several zoologists and paleontologists at the Loch, gives hope that we may indeed be on the verge of resolving the mystery first recorded by St. Columba fourteen centuries ago.

Those readers who wish to consider in greater detail the more extensive photographic and sonar evidence collected to date by the Academy team should write for a copy of the article by Rines et al. (1976), available for $1.00 per copy from "Ness", Technology Review, Room E19-430, Massachusetts Institute of Technology, Cambridge, Mass. 02139.

I acknowledge my gratitude to Mr. Wyckoff and Mr. Dennis L. Meredith for the photos used here.

Literature and Further Reading

DINSDALE, T. 1973. The story of the Loch Ness monster. Target Books, London.

KLEIN, M. 1971. Sonar search at Loch Ness. Marine Technology Society, August.

MACKAL, R. T. 1976. The monsters of Loch Ness. Swallow Press, Chicago.

MORTIMER, C. H. 1973. The Loch Ness monster -- limnology or paralimnology? Limnol. Oceanogr., 18:343-345.

RINES, R.H., C. W. WYCKOFF, H. E. EDGERTON, and M. KLEIN. 1976. Search for the Loch Ness monster. Technol. Rev., 78:25-40 (see also editorial, p. 10-12, concerning the recent press coverage of the Rines group).

SAGAN, C. 1976. Detection times and number densities of rare mobile organisms: application to Loch Ness. Center for Radiophysics and Space Research (Cornell University), paper no. 638; submitted to Nature.

SCHEIDER, W. and P. WALLIS. 1973. An alternate method of calculating the population density of monsters i n Loch Ness. Limnol. Oceanogr., 18: 343.

SCOTT, P. and R. RINES. 1975. Naming the Loch Ness monster. Nature, 258: 466-468 (see also p. 655 for a report on the presentation before Parliament).

SHELDON, R. W. and S. R. KERR. 1972. The population density of monsters in Loch Ness. Limnol. Oceanogr., 17: 796-798.

SHELDON, R. W. and S. R. KERR. 1973. The Loch Ness monster: reply to comments of C. H. Mortimer. Limnol. Oceanogr., 18:345-346.

WHYTE, C. 1957. More than a legend. Hamish Hamilton, London.

WILEY, J. P., JR. 1976. Cameras, sonar close in on denizens of Loch Ness. Smithsonian, 7:96-102, 104-105, June.

WITCHELL, N. 1975. The Loch Ness story (revised edition). Penguin Books, Middlesex, England.

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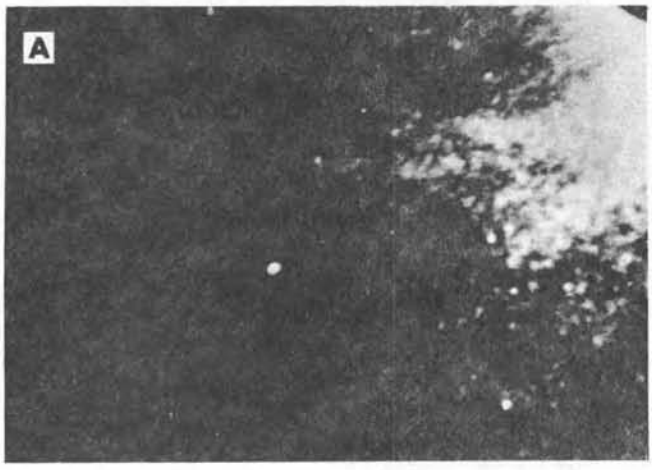
FIGURE 1 Three-dimensional map of Urquhart Bay, located midway along the west shore of Loch Ness. The ruins of Urquhart Castle stand on the promontory at the extreme left and the Enrick and Coiltie rivers enter Loch Ness here. Most of the work of Wyckoff's group has been done in the shallow waters along the gently-sloping shelf shown at the upper right in this drawing. The vertical dimension is expanded about 3 times to emphasize the bottom contours; horizontal lines mark 100 ft intervals of depth, the deepest one shown here at 500 ft. (copyright Academy of Applied Science)

FIGURE 2 The famous "surgeon's photograph" taken by Dr. Robert K. Wilson, a London gynecologist. The photo was taken in April 1934 about 2 mi north of Invermoriston, along the west shore of Loch Ness below Urquhart Bay. This is the first of a pair of photos, the second showing the object leaning "forward" when it submerged. Until the recent photos, this one attracted the most publicity since there has been no evidence of tampering with the negatives but it is merely a silhouette and shows no surface detail. It has been interpreted as the head and neck of a monster, although some claim it is merely a bird's neck or an otter's tail. (copyright Associated Newspapers)



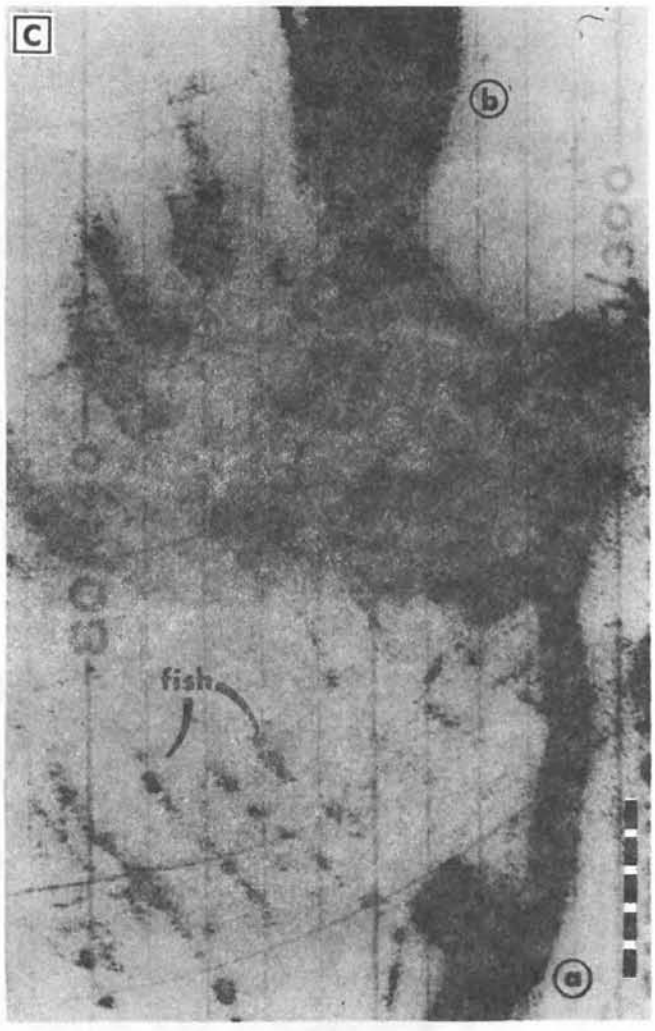


FIGURE 3 First underwater photographs and associated sonar record of the Loch Ness monster, taken on 9 August 1972. (A) and (B) are the so-called "flipper" photos, shown here computer-enhanced and duplicated with higher-than-normal photographic contrast. (B) was taken 45 sec after (A) and measurements from these indicate a "flipper" length of 4-6 ft; they are estimated to be about 4 ft from the camera. The tiny black triangles in one corner of each photo are caused by the strobe apparatus and should be disregarded. Simultaneously, the sonar record (C) was obtained using a Raytheon model DE 725C echo sounder with a frequency of 200 kHz. The record reads in 6-ft intervals (indicated by the faint vertical lines) from the sonar apparatus that was located to the left; the vertical axis reads in time, from 1:45 to 2:00 AM, bottom to top respectively. The period during which photos (A) and (B) were taken is indicated by the dashed line at the lower right in (C). According to Wyckoff, sonar experts have interpreted this record as showing a moving school of fish (the series of faint, parallel lines moving diagonally across the record) and two large objects (a, b) separated by a distance of about 12 ft; one of them (a) has large protuberances or "appendages" on one side. Both the sonar transducer and camera-strobe apparatus were located at depths of 35 and 45 ft, respectively, about 120 ft from shore (see Fig. 1). (copyright Academy of Applied Science)

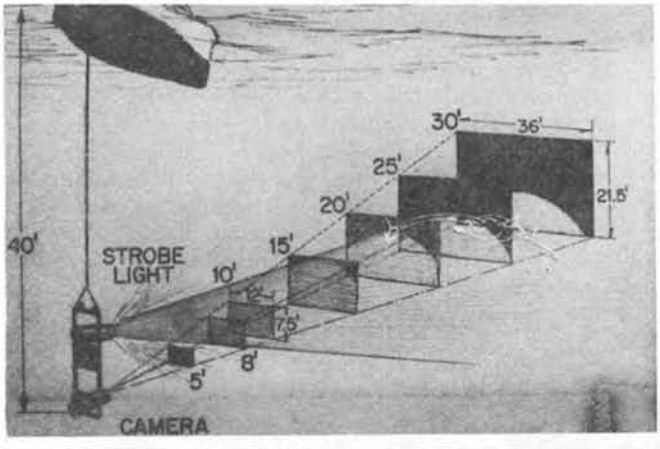


FIGURE 4 Camera-strobe arrangement for photographs shown in plate I, showing apparatus suspended from a boat. The camera field of view intersected the strobe beam at an angle in a way that only objects at a distance of 10 ft were fully illuminated. This geometric arrangement, together with light density measurements, was used by Wyckoff to determine the distance and size of an object. Included here is a schematic of the object shown in plate IA. At this distance the "body" would be fully illuminated but the "head," since it extends toward the camera, would cast a shadow over part of the "neck" making the object in plate IA appear to be two separate structures. (copyright Academy of Applied Science)